PART 5
PROCESS REQUIREMENT

CONTENTS

PART 5

PROCESS REQUIREMENT

Contents

5.0 PROCESS REQUIREMENT.....2
5.1 Sewage Treatment Plant.....2
5.2 Influent Wastewater Characteristics.....2
5.3 Effluent Quality Requirements.....2
5.4 Treatment Process.....2
5.5 Demolition or Interfaces and Tie-Ins with Existing Facilities.....2
5.6 Design of Plant Layout.....3
5.7 Design Requirements.....4
5.8 Hydraulic Design Requirement.....5
5.9 Design/Sizing Criteria and Other Requirements.....6

PART 5

PROCESS REQUIREMENT

5.0 PROCESS REQUIREMENT

Process, hydraulic and other plant design requirements for the, STPs of this Contract are described herein Part 5 – "Process Requirement".

5.1 Sewage Treatment Plant

Following table shows the design average flow capacity for STP

No.	Location	Name	Design Flow (MLD) for Ultrafiltration and UV dosing system
1	HSR Layout	*35 MLD Agara STP*	2.5

The refurbishment/up gradation for the STP with pumping system as required along with all associated ancillary works shall be designed for design flows and pollution loads with modification of treatment process as follows:

- **Inclusion of Ultrafiltration system downstream of Disc Filtration system followed by Ultraviolet system for Disinfection**

5.2 Influent Wastewater Characteristics

The influent wastewater characteristics to be used as the basis of design are listed in Paragraph 5.9 -"Design/Sizing Criteria and Other Requirements".

5.3 Effluent Quality Requirements

The treated effluent quality requirements to be met are listed in Paragraph 5.9 – "Design/Sizing Criteria and Other Requirements".

5.4 Treatment Process

The main treatment process train for modification shall consist of the major unit processes and components listed in Paragraph 5.9. This list shall not be considered as a comprehensive description. The Contractor shall provide a complete, fully functional facility designed for proper, easy operation and to meet the stated performance requirements. This shall include any and all

additional, ancillary, supporting, or other processes, components, equipment, or other items necessary to achieve these objectives, regardless of whether such items are explicitly listed in this Bidding Document or not.

The design/sizing criteria, minimum number of units, and other requirements for the various unit processes and components are listed in Paragraph 5.9

5.5 Demolition or Interfaces and Tie-Ins with Existing Facilities

All existing facilities that are to be demolished shall be properly decommissioned, removed, and appropriately disposed-off by the Contractor in accordance with all applicable laws, regulations, and standards. Items, components, or materials, whether buried, exposed, submerged, or otherwise, shall not be abandoned or left on site unless explicitly indicated in the Bidding Document. For facilities that are to be eventually demolished but must remain in service until alternate or replacement facilities are constructed and commissioned under this Contract, the Contractor shall ensure that the facilities are protected and remain functional until such time as the alternate or replacement facilities are constructed, tested, commissioned, and accepted by Employer.

All existing facilities that must remain in service permanently shall be protected by the Contractor such that they remain fully functional, operable, and serviceable throughout construction, testing, and commissioning of the new facilities. The Contractor shall be fully responsible for installation and, if necessary, ultimate removal of any temporary facilities or connections (piping, utilities, power, controls, etc.) that may be necessary to maintain existing facilities fully operational throughout construction and commissioning. Temporary or permanent interfaces between existing and new facilities may involve making connections or “tie-ins” to existing live structures, piping, wiring, cabling, equipment or other components. The Contractor shall be fully responsible for detailed design, planning, and implementation of such interfaces in a safe and secure manner.

5.6 Design of Plant Layout

The proposed STP components for refurbishment shall be laid out and fully contained within the respective designated site boundaries so as to logically interface with the U/S and D/S facilities of existing STP under this Contract and all existing infrastructure that may be present at the sites and that must remain in service, if and as appropriate.

The Contractor's proposed works shall clearly show the space allocated for all plant components, including those components and/or unit processes that are designated for present scope of construction or installation. Setbacks and clearances from the site boundary shall be provided as appropriate and as required by law.

All existing utilities (including water, sewer, power, or others, whether overhead or underground and whether physically located on the site or not) requiring to be relocated to accommodate the Contractor's proposed and approved site works shall be relocated by the Contractor at no additional cost and without interrupting provision of such utility services to users and customers. Such relocations shall be fully coordinated with the Employer.

The proposed layout for modification shall adhere to the following minimum requirements, regardless of whether or not such requirements or any related components are shown in any drawings or specifically listed or described in any part of the document included in the Contract Document.

- Minimum clear distance provided to permit safe and convenient access for operation and maintenance shall be 3m between adjacent treatment units or fixed structures and 1.2m between pieces of equipment.
- Access and maintenance lay down area shall be provided adjacent to all mechanical equipment.
- Proposed electrical equipment (except for motors) shall be located above the high flood level elevation for the site or for the effluent receiving water body, whichever is higher.
- Proposed process units / storage tanks shall be labeled with name, sizes and volume. Letters shall be of a size suitable for the application but shall not be less than 100mm high. Labels shall be located at 90-degree intervals at a suitable elevation.
- Proposed plant items for mechanical, electrical and instrumentation shall be fitted with a unique name plate bearing the individual plant reference name for the plant item.

5.7 Design Requirements

The following design requirements shall be meant for proposed works. These requirements shall be fully met regardless of whether or not such requirements or any related components are shown in any drawings and other documents included in the Contract Document.

- Proposed components shall be provided with appropriate isolation devices such as valves, gates, or other devices in order to allow isolation, drainage, cleaning, calibration, servicing, and maintenance of such components.
- Proposed equipment shall be arranged, and buildings and structures designed to permit safe and easy access to and removal of all equipment.
- Fixed runways, lifting eyes, cranes, hoists, or other appropriate devices and means shall be provided to permit safe and easy removal of all equipment for maintenance or any other purpose.
- Minimum 1.5 factor of safety shall be incorporated over maximum weight to lift while selecting the capacity of any type of lifting device.
- Inlets into tanks, or other structures via pipes, channels, valves, or gates shall be designed such that the incoming flow does not cause any damage or excessive wear whatsoever to the structure (including corrosion protection linings and/or coatings) or any equipment in the vicinity under any hydraulic condition, including but not limited to the condition when the structure is empty.
- Proposed walkways, flooring, hand railing, Plant, etc. shall be designed to take account of the prevailing conditions and be of corrosion-resistant materials.
- Proposed walkways and staircase shall be provided with non-skid floor tiles of industrial grade designed for human traffic live loads and equipment load that carried on walkway. Whereas all the admin building requirements including staircase, flooring etc., shall be as specified elsewhere in this Bidding Document.
- Proposed platforms, handrails/guardrails, ladders, stairs and safety chains shall be provided for proper, safe, and easy access to and/or operation of valves, gates, instruments, control panels, and other devices, equipment, or structures, as well as removal of the above items. All platforms and handrails shall be provided with toe guards of minimum 75 mm width.
- RCC staircases shall be provided to proposed plant units, flow dividing chambers and other structures to connect to the elevated RCC walkway platforms for which the height of the floor above finished ground level exceeds that in the prevailing standard.
- All piping routed under any type of structure or equipment shall be fully and completely encased in reinforced cement concrete, with the encasement thickness beyond the outer diameter of the pipe being at least 200 mm on all sides. The encasement shall extend along the pipe length for a minimum horizontal distance of 1500 mm in each direction beyond the footprint of the overlying structure or equipment.

- All piping connecting to, entering, or exiting any and all structures shall be provided with appropriate restrained flexible connections and/or joints at all such interfaces with structures to allow for differential movement between pipe and structure in all directions without stressing or breaking the pipes.
- Appropriate restrained flexible connections and/or joints shall be provided for all pipes where they connect to any and all of the following:
    - Equipment such as pumps, blowers, or inline devices
    - Valves
    - Wall, floor, or roof penetrations
- Where piping or other materials susceptible to damage from direct sunlight/ultraviolet radiation, they shall be protected from such light/radiation through the use of appropriate additives and/or coatings and shall be physically shielded from direct sunlight/ultraviolet radiation at all times (including prior to and during installation) in their normal service location using enclosures, covers, canopies, roofs, and/or other similar means.
- All spare requirements specified for disc filter cloth, and other spare parts of electromechanical equipment's shall be instantaneous. (i.e., equal amount of used spare shall be replaced with new spares to maintain the minimum spare quantity specified in bidding document) throughout the O&M period.

5.8 Hydraulic Design Requirement

Contractor shall submit self-explanatory hydraulic design calculations in editable MS-Excel format and shall ensure that the plant layouts and hydraulic profiles shall comply with the following specific and all other requirements as applicable and described below:

- Topographical survey information, benchmarks, contour maps, geotechnical/soil investigations, and effluent receiving water body high flood level (HFL) elevations for STP sites are included with these Bidding Documents and/or available from the Employer on request. However, the Employer makes no guarantees or representations whatsoever regarding this information. The Contractor's use of this information shall be at his own risk. The Contractor shall independently obtain any and all site information necessary for proper planning, design, construction and operation and maintenance of all Works/components in the Contract.
- All aspects of the design of the hydraulics shall be based on sound principles and good common engineering practice typical for sewage treatment works.
- Proposed process units shall be capable of passing the required peak sewage flows as specified.

- All the flows shall be evenly distributed between the numbers of process units in operation for all flow conditions.
- The hydraulic design calculations shall demonstrate the hydraulic functioning of the proposed works if any one of the process units were to be out of service for maintenance.
- Hydraulic calculations shall be based on the Hazen-Williams formulae for pipe and the Manning equation for open channel flow.
- Hazen-Williams co-efficient of 100 shall be considered for all liquid pipelines for gravity and pumping design.
- Manning co-efficient of 0.015 shall be considered in design.
- The division of flow between the individual treatment units shall be achieved by:
    - Non-submerged (i.e. with a positive freefall from weir invert to the water surface on the downstream side) overflow weirs followed by isolation gate.
    - Non-submerged downward opening overflow weir gates.
- Sharp crested weirs with free discharge shall be used and shall be designed to include adequate provision for maintaining atmospheric pressures beneath the nappe.
- A positive freefall of at least 150mm shall be provided to upstream weir crests under peak flow conditions with all streams operational.
- All the flow distribution boxes shall be equipped with adjustable weir plate for equal flow distribution to each side of weir plate. Further, weir followed by isolation gate shall be provided for each weir side of flow distribution box.
- SS 316 weir plate with minimum 6mm thick shall be provided on each weir side of flow distribution box and shall be capable to adjust at least 75mm of its height unless specified otherwise.
- All below water RCC columns proposed shall be circular in shape.
- All pumps shall have flooded suction and negative suction shall not be allowed in pump selection.
- Maximum pipe flow velocity shall be no more than 1.0 m/s for all gravity flow and pump suction lines unless specified otherwise.
- Maximum pipe flow velocity shall be no more than 1.5 m/s for all pumped discharge lines unless specified otherwise.
- For channels, the maximum velocity shall be no more than 1.0 m/s.
- For liquids the maximum velocity through gate opening shall be no more than 0.8 m/s unless specified otherwise.
- The size of magnetic flow meter shall be same as that of pipe diameter unless specified otherwise.

5.9 Design/Sizing Criteria and Other Requirements

Contractor shall submit self-explanatory process design calculations in editable MS-Excel format considering the requirements specified in Part 5 and elsewhere in this Bidding Document.

Below Notes are pertaining to design and sizing criteria specified in following tables:

Item/ Parameter/ Description	Units	Agara STP
General Information		
Plant Capacity	MLD	35
Capacity of Ultrafiltration and UV system	MLD	2.5
Peak Factor		2.25
Inlet Water Quality for Design (Outlet of Disc Filter system and inlet to proposed works)		
pH – Instantaneous range		6.5-8.0
BOD5 at 20°C – Maximum monthly average	mg/L	≤ 20.00
COD – Maximum monthly average	mg/L	≤ 50.00
TSS – Maximum monthly average	mg/L	≤ 10.00
TN - Maximum monthly average	mg/L	≤ 10.00
Total Phosphorus - Maximum monthly average	mg/L	1.00
Residual Chlorine - Instantaneous	mg/L	1
Fecal Coliform - Maximum monthly average	MPN/ 100 mL	≤ 230.00
Max. Ambient Temperature	0C	45.00
Outlet of UF+UV system (Treated Effluent Quality)		
pH – Instantaneous range		6.5-8.0

Item/ Parameter/ Description	Units	Agara STP
BOD5 at 20°C – Maximum monthly average	mg/L	≤ 5.00
Turbidity – Maximum monthly average	NTU	< 2.0
COD – Maximum monthly average	mg/L	≤ 30.00
TSS – Maximum monthly average	mg/L	nil
TN - Maximum monthly average	mg/L	≤ 10
Total Phosphorus - Maximum monthly average	mg/L	≤1.00
Fecal Coliform - Maximum monthly average	MPN/ 100 mL	BDL
Colour		No Colourless
Odour		No Foul odour
Receiving water body high flood level	m	Refer HFD drawing furnished elsewhere
Ultrafiltration system		**Proposed**
No. of UF streams		2
Net average output	m3/h	104
Net average output from the working UF streams	m3/d	2500
Recovery per UF stream		≥90% minimum
Gross flux	LMH	30 to 40
Design loading factor on UF system for TSS		2

Technical Particular	**Parameters**	
Length of Membrane Module	mm	As per Vendor Recommendation
Width of Membrane Module	mm	As per Vendor Recommendation
Height of Membrane Module	mm	As per Vendor Recommendation
Dry Weight of Membrane Module	Kg	As per Vendor Recommendation
Maximum No. of Membrane Rows which can be installed per Module	No.	As per Vendor Recommendation
Filtration Area of each Row	m2	As per Vendor Recommendation
Filtration Area of Module	m2	As per Vendor Recommendation
Membrane Fiber Chemistry		PVDF (Braided Fiber or Hollow Fiber (Reinforced)
Fiber Support Chemistry		Polyester or if any other as per Vendor Recommendation
Membrane Module Assembly		Single Header
Membrane Module Frame or Rack Material		SS 316
Spare space for module per Train		10%
Nominal fiber Diameter (OD)	mm	1.2 to 2.6 mm

Technical Particular	**Parameters**	
Flow Direction		Out to– In
Nominal Pore Size	micron	0.03 microns (maximum)
Feed Temperature		20 to 38 degree C
Housing Material and Permeate Collection Tube Material		UPVC ABS, PVC, PE Manifold
Permeate Connection Type		Grooved Coupling of suitable size
Air Connection Type		Grooved Coupling of suitable size
Maximum Filtration Transmembrane Pressure	Bar	0.6
Maximum Back Wash/ flush Transmembrane Pressure	Bar	0.6
Acceptable Range of Cleaning pH values		2.0 – 10.5
Lifetime Total Chlorine Exposure	ppm-hrs.	5,00,000
Maximum chlorine Concentration	mg/l	1,000 (as $NaOCl)^3$
Minimum Operating life for Membrane	Years	10
Specific Energy Consumption	kWh/m3 (Treated)	Vendor to Provide details
Individual Modules are accessible for any replacement/future modules additions	Yes/No	Vendor to Provide details, If Yes, provide details of provisions for Spare modules.

(b)	Inlet Parameters:

	(i)	Tertiary Treatment		After Ultrafiltration
	(ii)	Design Flow	m3/h	104
	(iv)	Inlet TSS after Secondary treatment	mg/l	1
	(viii)	Temperature range	Deg C	25 – 28
	(x)	Fecal coliform	MPN/100 ml	< 230
	(xi)	UV Transmittance	At 254 nanometer	More than 87% (1.5mm wall thickness)
(c)	Outlet Parameters:			
	(i)	Fecal coliform	MPN/100 ml	BDL (95 % Compliance Required)
	(ii)	RED Dosage (min)	mJ/cm2	MS2 RED of 30 mJ/cm2 at max. flow
(d)	UV system			
	(i)	No of UV channel or pipe working	Nos	1
	(ii)	No of UV channel standby	Nos	Not required
	(iii)	No of UV banks/ modules working per channel/ pipe	Nos	Supplier to specify
	(iv)	No of UV banks per channel or pipe	Nos	1
	(v)	No of UV banks/ Module standby per channel or pipe	Nos	1 No. (min)*
(e)	UV bank			

	(i)	No of Modules per bank	Nos	Supplier to specify
	(ii)	No of UV lamps per module	Nos	Supplier to specify
	(iii)	Total lamps per bank	Nos	Supplier to specify
	(iv)	Angle of inclination of lamps	degree	0°, horizontal arrangement
	(v)	Horizontal/Vertical		Parallel to the direction of water flow
	(vi)	No of UV intensity sensor/bank	Nos	1 piece/group
(f)	Lifting Arrangement & Cleaning System			
	(i)	Module/Bank lifting arrangement		Yes
	(ii)	Details of lifting arrangement (Type/kW rating)		Electric hoist, 0.75kW
	(iii)	Automatic Wiping system		Yes
	(iv)	No of wiper strokes /time interval		Automatically adjustable
	(v)	Type of drive for lamp cleaning and KW rating		0.75kW
	(vi)	Type of cleaning		Mechanical/ Chemical
	(vii)	Chemical used for chemical cleaning		*
	(viii)	Chemical consumption	*	*
(g)	UV lamp and Ballast			
	(i)	Dimension of lamp (Dia	mm	Supplier to specify

		& Length)		
	(ii)	Type of lamp		High Strength Low Pressure Amalgam
	(iii)	Type of ballast		One control one
	(iv)	UVC Wavelength	nanometre	253.7nm
	(v)	Turn down of lamp (as % of UVC ballast power input)	Max-Min %	50-100
	(vi)	Total Harmonic Distortion of ballast	%	Less than 5%
	(vii)	Power factor of ballast		98%
	(viii)	Efficiency of ballast		98%
	(ix)	Quartz Sleeve Fouling Factor (FF)		0.92
(h)	Life of components			
	(i)	Lamp life	Operating hours	12000 hours
	(ii)	Quartz sleeve	Years	5
	(iii)	Ballast	Years	5
	(iv)	Avg ON/OFF cycles	per 24 hours	4
	(v)	UV intensity sensor (to measure at 254 nm)		4-20mA
(i)		MOC of UV system components		
	(i)	Lamp		IP68
	(ii)	Quartz sleeve		IP68

	(iii)	Wiper		Fluororubber
	(iv)	wetted metallic parts		SS 316
	(v)	All other UV exposed parts		SS 316, Fluororubber
	(vi)	Control & power panels		With control and power panel
(j)	Water Level Controller			
	(i)	Type		Automatic water level controller/bottom opening
(k)	Electrical Panels			
	(i)	No of panels		1
	(ii)	Power distribution Centre (PDC)	Nos	1
	(iii)	PLC panel	Nos	1
	(v)	Panel IP rating		IP 65

5.10 PLC SPECIFICATIONS:

- The PLC shall be non-redundant type for UF system only.
- PLC of individual equipment shall be selected to carry out necessary operations without overloading the PLC memory.
- The PLC shall have adequate I/O per card.
- There shall be 15% spare I/O of each type.
- The CPU shall not be loaded more than 60% of its capacity.
- Retentively it shall be 100% to save the recorded data and saving the programmed logic,
  other attributes connected with system for power & system failure.
- Change in program / modifications to program shall be possible by a portable laptop.

5.11 HMI/SCADA SYSTEM

The HMI system shall be designed as a minimum 7”, color, touchscreen on the panel.

5.12 UV DISINFECTION SYSTEM

All materials, equipment and appurtenances required to provide an open channel, gravity flow, low pressure high output (LPHO) / medium pressure ultraviolet lamp (UV) disinfection system complete with an automatic chemical/mechanical cleaning system and variable output lamp drivers. The UV system shall be complete and operational with all control equipment and accessories as specified herein. This system shall be capable of disinfecting effluent water quality standards.

5.13 PERFORMANCE REQUIREMENTS:

Provide a UV disinfection system complete with UV Banks and automatic lifting mechanism or EOT Crane as applicable, System Control Center, Power Distribution Centers if applicable, and Weir Gate / Other suitable mechanisms as Water Level Controller(s).

End of Part 5